CLAIMS

1. An endoscope inserting direction detecting method comprising:

a first step of receiving an endoscopic image;

a second step of detecting the direction of a change in brightness in the endoscopic image; and

a third step of producing information concerning an endoscope inserting direction, in which an endoscope should be inserted, on the basis of the result of the detection.

2. An endoscope inserting direction detecting method according to Claim 1, further comprising a fourth step of determining sampling-pixels out of all pixels representing the endoscopic image, wherein:

the direction of a change in brightness is detected in each sampling-pixel.

3. An endoscope inserting direction detecting method according to Claim 1, wherein the direction of a change in brightness is detected using spatial differentiations.

4. An endoscope inserting direction detecting method according to Claim 2, wherein the direction of a change in brightness is detected using spatial differentiations.

5. An endoscope inserting direction detecting method comprising:

a first step of determining an inserting-direction

candidate, that is, a candidate for an endoscope inserting direction in which an endoscope should be inserted;

a second step of receiving an endoscopic image;

a third step of detecting the direction of a change in brightness in the endoscopic image;

a fourth step of evaluating the similarities among a plurality of inserting-direction candidates and the direction of the change in brightness; and

a fifth step of determining an endoscope inserting direction, in which an endoscope should be inserted, on the basis of the result of the evaluation.

6. An endoscope inserting direction detecting method according to Claim 5, further comprising:

a sixth step of determining sampling-pixels out of all pixels representing the endoscopic image; and

a seventh step of detecting the direction of a change in brightness using N sampling-pixels (where N denotes an integer), expressing the direction of a change in brightness in the form of a first vector $\underline{Vn}$ (where $1 \leq n \leq N$), expressing the inserting-direction candidates in the form of second vector $\underline{Uk}$ (where $1 \leq k \leq K$) defined to originate from the locations of the sampling-pixels determined at the sixth step, and evaluating the similarities among the plurality of inserting-direction candidates and the direction of the change in brightness, wherein:

at the seventh step, an angle at which the first vector Vn and each of the second vectors Uk meets is evaluated.

7. An endoscope inserting direction detecting method according to Claim 6, wherein: an evaluation value εk about a calculated value between the first vector Vn and each of the second vectors Uk is calculated during the evaluation; and at the fifth step, an inserting-direction candidate expressed as a second vector Uk that optimizes the evaluation value εk is adopted as an endoscope inserting direction.

8. An endoscope inserting direction detecting method according to Claim 7, wherein: the evaluation value εk is a sum of angles between the first vector Vn and the second vectors Uk defined based on the sampling-pixels or a function based on the angles; and at the fifth step, an inserting-direction candidate expressed as a second vector Uk that optimizes the evaluation value εk is adopted as an endoscope inserting direction.

9. An endoscope inserting direction detecting method according to Claim 5, wherein the direction of a change in brightness is detected using spatial differentiations.

10. An endoscope inserting direction detecting method according to Claim 6, wherein the direction of a change in brightness is detected using spatial differentiations.

11. An endoscope inserting direction detecting method

according to Claim 7, wherein the direction of a change in brightness is detected using spatial differentiations.

12. An endoscope inserting direction detecting method according to Claim 8, wherein the direction of a change in brightness is detected using spatial differentiations.

13. An endoscope inserting direction detecting method comprising:

a first step of receiving an endoscopic image;

a second step of extracting pixels, which represent high densities, from data of the endoscopic image;

a third step of defining an approximate expression for providing an approximate state of a distribution of sampling-pixels; and

a fourth step of determining an endoscope inserting direction, in which an endoscope should be inserted, on the basis of the result of the approximation.

14. An endoscope inserting direction detecting method according to Claim 13, wherein at the third step, the distribution of sampling-pixels is approximated to a curve.

15. An endoscope inserting direction detecting method according to Claim 13, further comprising a fifth step of evaluating an error between the distribution of sampling-pixels and the result of the approximation.

16. An endoscope inserting direction detecting method according to Claim 14, further comprising a fifth step of

evaluating an error between the distribution of sampling-pixels and the result of the approximation.

17. An endoscope inserting direction detecting method according to Claim 15, wherein: at the third step, the distribution of sampling-pixels is approximated to an arc defined with such parameters as coordinates of a center and a radius; an arc that has the smallest error relative to the distribution of sampling-pixels is determined during the approximation; and the direction of the center of the defined arc is adopted as an endoscope inserting direction.

18. An endoscope inserting direction detecting method according to Claim 17, further comprising a sixth step of determining a plurality of inserting-direction candidates, that is, candidates for an endoscope inserting direction, wherein an inserting-direction candidate closest to the direction of the center of the arc is adopted as an endoscope inserting direction.

19. An endoscope inserting direction detecting method according to Claim 13, wherein the sampling is performed using a threshold.

20. An endoscope inserting direction detecting method according to Claim 14, wherein the sampling is performed using a threshold.

21. An endoscope inserting direction detecting method according to Claim 15, wherein the sampling is performed

using a threshold.

22. An endoscope inserting direction detecting method according to Claim 16, wherein the sampling is performed using a threshold.

23. An endoscope inserting direction detecting method according to Claim 17, wherein the sampling is performed using a threshold.

24. An endoscope inserting direction detecting method according to Claim 18, wherein the sampling is performed using a threshold.

25. An endoscope inserting direction detecting method comprising:

a first step of receiving an endoscopic image;

a second step of sampling-pixels, which represent high densities, from the data of the endoscopic image;

a third step of determining a direction on the basis of a combination of the sampling-pixels; and

a fourth step of determining an endoscope inserting direction, in which an endoscope should be inserted, on the basis of the determined direction.

26. An endoscope inserting direction detecting method according to Claim 25, wherein at the third step, two of the sampling-pixels are paired, and the direction of the center of a circle passing the two paired pixels is determined.

27. An endoscope inserting direction detecting method

according to Claim 25, further comprising a fifth step of determining a plurality of directions by changing paired sampling-pixels and evaluating the gathering state of the directions, wherein:

an endoscope inserting direction is determined based on the result of the evaluation.

28. An endoscope inserting direction detecting method according to Claim 26, further comprising a fifth step of determining a plurality of directions by changing paired sampling-pixels and evaluating the gathering state of the directions, wherein:

an endoscope inserting direction is determined based on the result of the evaluation.

29. An endoscope inserting direction detecting method according to Claim 25, further comprising a sixth step of determining a plurality of inserting-direction candidates, that is, candidates for an endoscope inserting direction, wherein:

an inserting-direction candidate closest to the determined direction is adopted as an endoscope inserting direction.

30. An endoscope inserting direction detecting method according to Claim 26, further comprising a sixth step of determining a plurality of inserting-direction candidates, that is, candidates for an endoscope inserting direction,

wherein:

an inserting-direction candidate closest to the determined direction is adopted as an endoscope inserting direction.

31. An endoscope inserting direction detecting method according to Claim 27, further comprising a sixth step of determining a plurality of inserting-direction candidates, that is, candidates for an endoscope inserting direction, wherein:

an inserting-direction candidate closest to the determined direction is adopted as an endoscope inserting direction.

32. An endoscope inserting direction detecting method according to Claim 25, wherein the sampling is performed using a threshold.

33. An endoscope inserting direction detecting method according to Claim 26, wherein the sampling is performed using a threshold.

34. An endoscope inserting direction detecting method according to Claim 27, wherein the sampling is performed using a threshold.

35. An endoscope inserting direction detecting method according to Claim 28, wherein the sampling is performed using a threshold.

36. An endoscope inserting direction detecting method

according to Claim 29, wherein the sampling is performed using a threshold.

37. An endoscope inserting direction detecting method comprising:

a first step of receiving an endoscopic image;

a second step of sampling pixels, which represent high values, from the data of the endoscopic image;

a third step of defining an approximate expression for providing an approximate state of a distribution of sampling-pixels;

a fourth step of evaluating an error between the distribution of sampling-pixels and the result of the approximation;

a fifth step of determining an endoscope inserting direction, in which an endoscope should be inserted, on the basis of the distribution of sampling-pixels; and

a sixth step of producing information concerning the determined inserting direction, wherein:

if the result of the approximation proves unsatisfactory during the evaluation of an error from the result of the approximation, at least one of determination of an inserting direction and production of information is not performed.

38. An endoscope inserting direction detecting method according to Claim 37, wherein the approximate expression

provides an approximate shape of an arc, and the evaluation is evaluation of an error between the distribution of sampling-pixels and the result of the approximation based on the approximate expression.

39. An endoscope inserting direction detecting method according to Claim 38, wherein an error between the distribution of sampling-pixels and the result of the approximation based on the approximate expression is evaluated using a threshold.

40. An endoscope inserting direction detecting method according to Claim 38, wherein the approximate expression is an equation of a circle.

41. An endoscope inserting direction detecting method comprising:

a first step of receiving endoscopic images time-sequentially;

a second step of detecting the direction of a shift in the time-sequentially received plurality of endoscopic images; and

a third step of determining an endoscope inserting direction, in which an endoscope should be inserted, on the basis of the result of the detection performed at the second step.

42. An endoscope inserting direction detecting method according to Claim 41, further comprising a fourth step of

detecting the direction of extension of a tubular shape using the endoscopic images, wherein:

at the second step, the direction of a shift is determined based on the result of the detection performed to detect the direction of extension of a tubular shape at the fourth step; and

if the direction of extension is not detected at the fourth step, an endoscope inserting direction is determined.

43. An endoscope inserting direction detecting method according to Claim 42, further comprising a fifth step of sampling pixels, which represent low densities, from the endoscopic images, wherein:

at the fourth step, the direction of extension of a tubular shape is determined based on a distribution of sampling-pixels, and at least one pixel is determined as a reference point used to determine the direction of a shift; and

at the second step, the direction of a shift is determined based on a shift of the reference point.

44. An endoscope inserting direction detecting method according to Claim 43, wherein the sampling is performed using a threshold.

45. An endoscope inserting direction detecting method according to Claim 43, wherein at the fourth step, the direction of a shift is detected based on a shift vector.

46. An endoscope inserting direction detecting method according to Claim 44, wherein at the fourth step, the direction of a shift is detected based on a shift vector.

47. An endoscope inserting direction detecting method comprising:

a first step of receiving an endoscopic image;

a second step of detecting an endoscope inserting direction, in which an endoscope should be inserted, on the basis of the endoscopic image; and

a third step of producing information concerning the detected inserting direction, wherein:

a plurality of detecting algorithms is included in order to detect the inserting direction; and

any of the detecting algorithms is selected based on the endoscopic image.

48. An endoscope inserting direction detecting system comprising:

an endoscopic image inputting means for receiving an endoscopic image;

an inserting direction detecting means including a plurality of detecting algorithms for the purpose of detecting an endoscope inserting direction, in which an endoscope should be inserted, using the endoscopic image; and

an insertion aid information producing means for

producing insertion aid information on the basis of the detected inserting direction, wherein:

the endoscope inserting direction detecting system further comprises a detecting algorithm changing means for changing detecting algorithms, any of which the inserting direction detecting means adopts, according to the endoscopic image.

49. An endoscope inserting direction detecting method according to Claim 48, further comprising a display means on which the insertion aid information is displayed.

50. An endoscope inserting direction detecting method comprising:

a first step of receiving an endoscopic image;

a second step of judging from the endoscopic image whether an endoscope is located too closely to an object of observation; and

a third step of producing information concerning manipulations of the endoscope on the basis of the result of the detection.

51. An endoscope inserting direction detecting method according to Claim 50, wherein the detection is performed based on at least one of the tone of the endoscopic image and a statistic value of pixel values.

52. An endoscope inserting direction detecting method according to Claim 50, wherein the information to be

produced prompts pull-back of the endoscope.

53. An endoscope inserting direction detecting method according to Claim 51, wherein the information to be produced prompts pull-back of the endoscope.